

IN THE CLAIMS

What is claimed is:

1. A method for enhancing one or more properties of body tissue to be repaired or joined by surgical staples comprising the steps of:

5 providing a surgical stapler including a staple anvil and a staple cartridge each positioned adjacent a distal end of the surgical stapler and operable in juxtaposition relative to each other, the staple cartridge including:

a working surface;

one or more rows of individual staple slots formed in the working surface;

10 a plurality of surgical staples individually disposed within the individual staple slots;

a driving member for firing the surgical staples from their slots and against the staple anvil;

15 a body tissue property enhancing system configured and adapted to enhance one or more properties of the body tissue to be repaired or joined by the surgical staples formed by firing them into body tissue, the body tissue property enhancing system including a reservoir of biocompatible wound closure material and a plurality of ducts in communication with the reservoir and the working surface of the cartridge; and

20 a plurality of deployable needles each having a tip, the needles being adapted and disposed in the ducts such that the tips can be extended out of the working surface of the staple cartridge to penetrate at least a layer of adjacent layers of body tissue and to allow the biocompatible wound closure material to be delivered along the exterior of the needles to penetrate one or more layers of body tissue;

25 approximating the staple anvil and staple cartridge with adjacent layers of body tissue therebetween; and

30 firing the surgical stapler, wherein firing of the surgical stapler includes driving the plurality of surgical staples through the adjacent layers of body tissue to mechanically secure the layers of body tissue together and concomitantly activating the body tissue enhancing system to enhance one or more properties of the adjacent layers of repaired or joined body tissue.

2. The method according to claim 1, wherein activating of the body tissue property enhancing system includes delivering an amount of the biocompatible wound closure material to at least one of or between the adjacent layers of repaired or joined body tissue.

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3. The method according to claim 1, wherein upon firing of the surgical stapler, the biocompatible wound closure material is expelled from the reservoir of the staple cartridge.

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4. The method according to claim 3, wherein in the providing step each of the plurality of deployable needles is normally biased to a non-extended position and is movable against the bias to the extended position.

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5. The method according to claim 1, wherein the activating of the body tissue property enhancing system includes delivering an amount of energy to at least one of or between the adjacent layers of body tissue to cauterize at least one of or the adjacent layers of body tissue.

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6. The method according to claim 1, wherein the plurality of deployable needles are adapted to deliver the amount of energy to at least a layer of the body tissue to cauterize the body tissue.

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7. The method according to claim 1, wherein the biocompatible wound closure material is an adhesive material.

8. The method according to claim 7, wherein the adhesive material is comprised of a protein derived, aldehyde based adhesive material.

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9. The method according to claim 7, wherein the adhesive material is comprised of an albumin/glutaraldehyde material.

10. The method according to claim 7, wherein the adhesive material is a cyanoacrylate-based material.

11. The method according to claim 1, wherein the biocompatible wound closure material is a tissue sealant material.

12. The method according to claim 11, wherein the tissue sealant material is comprised of a synthetic polyethylene glycol-based hydrogel material.

13. The method according to claim 1, wherein the biocompatible wound closure material is a hemostat.

14. The method according to claim 13, wherein the hemostat is comprised of a combination of fibrinogen and thrombin.

15. A surgical stapler comprising:
a first jaw adapted to receive a staple cartridge in a distal end of the first jaw, the staple cartridge containing a plurality of individual surgical staples, and having a working surface with a plurality of staple slots formed therein;
a second jaw having a staple anvil in a distal end of the second jaw, such that during the operation of the surgical stapler the staple cartridge and the staple anvil can be approximated relative to one another;
a driving member for firing the surgical staples from their staple slots and against the approximated staple anvil;
a body tissue property enhancing system for enhancing one or more properties of body tissue to be repaired or joined by the surgical stapler, the body tissue property enhancing system including:
a biocompatible wound closure material dispensing system for dispensing an amount of surgically biocompatible wound closure material to a target staple site during at least one of prior to, after and concomitant with a firing of the surgical stapler to

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expel the plurality of staples loaded in the staple cartridge, the body tissue property enhancing system comprising at least one reservoir disposed in the staple cartridge for containing the biocompatible wound closure material therein;

5 a plurality of ducts formed in the staple cartridge, wherein the plurality of ducts communicate with and extend from the at least one adhesive reservoir to the working surface of the staple cartridge; and

10 a plurality of deployable needles each having a tip, the needles being adapted and disposed in the ducts of the staple cartridge such that their tips can be extended out of the working surface of the staple cartridge to penetrate at least a layer of the adjacent layers of body tissue and to allow the biocompatible wound closure material to be delivered along the exterior of the needles to penetrate one or more layers of the body tissue.

15 16. The surgical stapler according to claim 15, wherein the first jaw is adapted to receive a drive member being adapted to be slidably disposed within the staple cartridge, the drive member being adapted to force the biocompatible wound closure material from the reservoir out through the plurality of ducts and about the needles disposed therein as the drive member is displaced in a distal direction, to allow the biocompatible wound closure material to penetrate into the body tissue to be repaired or
20 joined.

17. The surgical stapler according to claim 16, wherein the staple cartridge further comprises:

25 one or more laterally spaced rows of individual staple slots, the rows of staple slots extending along the staple cartridge;

a plurality of individual surgical staples having a back span and disposed, one each, within the individual staple slots; and

30 a plurality of staple pushers disposed one each within the staple slots and in a position to push one of the plurality of staples from the slot, wherein the drive member is adapted to displace the staple pushers into the slots and to concomitantly expel a quantity of the biocompatible wound closure material about the needles and out through the

plurality of ducts.

18. The surgical stapler according to claim 16, wherein the biocompatible wound closure material dispensing system further includes a flexible liner extending
5 longitudinally through the staple cartridge, wherein the liner prevents the biocompatible wound closure material from contacting the drive member as the drive member is displaced distally through the staple cartridge.

19. The surgical stapler according to claim 16, wherein the plurality of needles
10 have a tip, a first position wherein the needles are entirely retained within the staple cartridge and a second position wherein the tips of the plurality of needles project out from the working surface of the staple cartridge.

20. The surgical stapler according to claim 19, wherein each of the plurality of
15 needles is biased to the first position.

21. The surgical stapler according to claim 15, wherein the surgical stapler is for performing open gastrointestinal anastomosis operations.

22. The surgical stapler according to claim 15, wherein the surgical stapler is for performing endoscopic or laparoscopic gastrointestinal operations.

23. The surgical stapler according to claim 15, wherein the surgical stapler is for performing end-to-end anastomosis operations.

24. The surgical stapler according to claim 15, wherein the biocompatible wound closure material is an adhesive comprised of a protein derived, aldehyde-based adhesive material.

25. The surgical stapler according to claim 24, wherein the biocompatible wound closure material is an adhesive comprised of an albumin/glutaraldehyde material.

26. The surgical stapler according to claim 24, wherein the biocompatible wound closure material is an adhesive comprised of a cyanoacrylate-based material.

5 27. The surgical stapler according to claim 15, wherein the biocompatible wound closure material is a tissue sealant material.

28. The method of claim 27, wherein the tissue sealant material is comprised of a synthetic polyethylene glycol-based hydrogel material.

10 29. The surgical stapler according to claim 15, wherein the biocompatible wound closure material is a hemostat.

30. The surgical stapler according to claim 15, wherein the plurality of ducts
15 are positioned adjacent to or aligned between the one or more laterally spaced apart rows of staple slots.

31. The surgical stapler according to claim 15, wherein each of the plurality of
20 deployable needles is provided with a retracting element for withdrawing each of the plurality of deployable needles back into the staple cartridge after a firing of the surgical stapler.

32. A surgical stapler comprising:
a first jaw adapted to receive a staple cartridge in a distal end of the first jaw, the
25 staple cartridge containing a plurality of individual surgical staples, and a working surface with a plurality of staple slots formed therein;

a second jaw having a staple anvil in a distal end of the second jaw, such that
during the operation of the surgical stapler the staple cartridge and the staple anvil can be approximated relative to each other;

30 a driving member for firing the surgical staples from the staple slots and against the approximated staple anvil; and

a tissue cauterizing system operatively associated with the staple cartridge for enhancing one or more properties of adjacent layers of body tissue to be repaired or joined by the surgical stapler, the tissue cauterizing system including a plurality of deployable needles each having a tip, the needles being adapted and disposed in the cartridge such that their tips can be extended out of the working surface of the staple cartridge to penetrate at least a layer of the adjacent layers of body tissue and to deliver electrosurgical energy to the body tissue during at least one of before, after and concomitant with firing of the surgical stapler.

33. The surgical stapler according to claim 32, wherein the tissue cauterizing system comprises:

a source of electrical energy electrically connected to the surgical stapler via a first and a second power line, and wherein the plurality of deployable needles have a first position wherein the plurality of deployable needles are entirely retained within the staple cartridge and a second position wherein the tip of each of the plurality of deployable needles projects from the staple cartridge.

34. The surgical stapler according to claim 33, wherein the first jaw includes the driving member being adapted to be slidably received within the staple cartridge, the driving member being adapted to displace each of the plurality of deployable needles from the first position to the second position.

35. The surgical stapler according to claim 34, wherein the driving member includes an energy transmission strip, wherein the energy transmission strip is electrically connected to the first power line and electrically interconnects each of the plurality of deployable needles with the first power line.

36. The surgical stapler according to claim 35, wherein each of the plurality of deployable needles and the transmission strip are made from an electrically conductive material.

37. The surgical stapler according to claim 36, wherein the staple anvil is electrically connected to the second power line.

38. The surgical stapler according to claim 37, wherein when the plurality of deployable needles is in the second position and the distal end of each of the plurality of deployable needles penetrates into tissue at the target staple site the tip of the plurality of needles do not contact the staple anvil.

39. The surgical stapler according to claim 38, wherein each of the plurality of deployable needles is biased to the first position.

40. The surgical stapler according to claim 37, wherein the tissue cauterizing system includes a plurality of springs disposed, one each, about each of the plurality of deployable needles to bias each of the plurality of deployable needles to the first position.

41. The surgical stapler according to claim 33, wherein the source of electrical energy is an electrosurgical generator.

42. A surgical stapler including a first jaw and a second jaw having a staple anvil, in a distal end thereof, the surgical stapler comprising:

a staple cartridge selectively receivable in the first jaw, the staple cartridge including:

one or more laterally spaced apart rows of staple slots formed in an upper surface thereof;

a plurality of surgical staples disposed, one each, within the staple slots;

a plurality of staple pushers disposed, one each, within the staple slots in a position to push and eject each of the plurality of staples from the staple slots; and

a plurality of deployable needles disposed within the staple cartridge, each of the plurality of deployable needles having a first position wherein the needle is entirely retained within the staple cartridge and a second position wherein a tip portion of the needle projects from the staple cartridge;

a driving member operatively associated with the first jaw, the driving member being adapted to be slidably received within the staple cartridge and to transform a linear displacement thereof into a concomitant transverse displacement of the plurality of staple pushers and of the plurality of deployable needles, the drive member including an energy transmission strip extending longitudinally along the length thereof; and

a source of electrical energy electrically connected to the surgical stapler, the source of electrical energy including:

a first power line electrically connected to the staple anvil; and

a second power line electrically connected to the transmission strip of the drive member and electrically communicable with each of the plurality of deployable needles as the driving member is displaced in a distal direction through the staple cartridge.

43. The surgical stapler according to claim 42, wherein each of the plurality of deployable needles and the transmission strip are made from an electrically conductive material.

44. The surgical stapler according to claim 42, wherein when each of the plurality of deployable needles is in the second position the tip of each of the plurality of deployable needles penetrates into tissue at the target staple site and does not contact the staple anvil.

45. The surgical stapler according to claim 42, wherein each of the plurality of deployable needles is biased into the first position.

46. The surgical stapler according to claim 42, wherein the tissue cauterizing system includes a plurality of springs disposed, one each, about each of the plurality of deployable needles to bias each of the plurality of deployable needles into the first position.

47. A surgical staple cartridge configured and adapted to be removably received within a surgical stapler, the staple cartridge comprising:

a working surface;

one or more laterally spaced apart rows of staple slots formed in the working surface;

a plurality of surgical staples disposed, one each, within the staple slots for mechanically securing adjacent layers of body tissue to one another; and

a tissue property enhancing system for enhancing one or more properties of body tissue to be repaired or joined by the surgical stapler, the tissue property enhancing system being configured and adapted to non-mechanically enhance the repaired or joined body tissue, the tissue property enhancing system including:

a wound closer material dispensing system for dispensing an amount of surgically biocompatible wound closure material to a target staple site during at least one of prior to, after and concomitant with a firing of the surgical stapler to expel a plurality of staples loaded in the staple cartridge, the tissue property enhancing system comprising at least one reservoir disposed in the staple cartridge for containing the biocompatible wound closure material therein;

a plurality of ducts formed in the staple cartridge, wherein the plurality of ducts extend from the at least one adhesive reservoir to the upper surface of the staple cartridge; and

a plurality of deployable needles each having a tip, the needles being adapted and disposed in the cartridge and ducts such that their tips can be extended out of the working surface of the staple cartridge and penetrate at least a layer of the adjacent layers of body tissue and to allow the biocompatible wound closure material to be delivered along the exterior of the needles and to penetrate one or more layers of the body tissue.

48. The surgical staple cartridge according to claim 47, wherein the tissue property enhancing system is configured and adapted to deliver an amount of the biocompatible wound closure material to at least one of the adjacent layers of body tissue to adhere the adjacent layers of body tissue to one another.

49. The surgical staple cartridge according to claim 47, wherein the tissue property enhancing system is configured and adapted to deliver an amount of biocompatible wound closure material between the adjacent layers of body tissue to
5 adhere the adjacent layers of body tissue to one another.

50. The surgical staple cartridge according to claim 47, wherein the staple cartridge includes a reservoir adapted to contain a quantity of the biocompatible wound closure material.

10 51. The surgical staple cartridge according to claim 50, wherein normally each of the plurality of deployable needles is biased into a retracted condition.

15 52. The surgical staple cartridge according to claim 45, wherein the body tissue property enhancing system is configured and adapted to deliver an amount of electrical energy to at least one of the adjacent layers of body tissue to cauterize the adjacent layers of body tissue to one another.

20 53. The surgical staple cartridge according to claim 47, wherein the plurality of deployable needles are adapted to deliver an amount of electrical energy to at least one of the layers of body tissue to cauterize the same.

25 54. The surgical staple cartridge according to claim 53, wherein each of the plurality of deployable needles is biased to a retracted condition.

30 55. A surgical stapler comprising:
a handle assembly;
a tubular body portion extending from the handle assembly;
a staple cartridge assembly operatively connected to a distal end of the tubular body, the staple cartridge including a pair of annular arrays of staple receiving slots,
wherein each staple receiving slot includes a surgical staple disposed therein for

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mechanically securing adjacent layers of body tissue to one another;

an anvil member operatively connected by a shaft to the distal end of the tubular body, opposite the staple cartridge assembly; and

a body tissue property enhancing system configured and adapted to non-
5 mechanically enhance the repairing or joining of the adjacent layers of body tissue to one another along an annular staple line formed by the firing of the surgical stapler, the body tissue property enhancing system including an annular array of needle receiving slots, and a plurality of deployable needles disposed, one each, in the annular array of needle receiving slots for delivering the body tissue enhancer.

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56. The surgical stapler according to claim 55, wherein the body tissue property reinforcing system is configured and adapted to deliver an amount of biocompatible wound closure material to the adjacent layers of body tissue to enhance the repairing or joining of the adjacent layers of body tissue to one another.

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57. The surgical stapler according to claim 55, wherein the biocompatible wound closure material is an adhesive and the body tissue property enhancing system is configured and adapted to deliver an amount of the adhesive into at least one of the adjacent layers of body tissue to adhere the adjacent layers of body tissue to one another.

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58. The surgical stapler according to claim 55, wherein the surgical stapler is for performing end-to-end anastomosis operations.

59. The surgical stapler according to claim 58, wherein the staple cartridge
25 assembly includes an staple pusher including a distal portion defining concentric rings of peripherally spaced fingers adapted to be receivable, one each, within a respective one of the pair of annular arrays of staple receiving slots and a respective one of the annular array of needle receiving slots.

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60. The surgical stapler according to claim 59, wherein each deployable needle is biased into a retracted position.

61. The surgical stapler according to claim 59, wherein each deployable needle is biased to a retracted position by a spring.

5 62. The surgical stapler according to claim 61, further including a plurality of capsules disposed, one each, in the array of needle receiving slots, between a respective needle and a respective finger which is receivable in the needle receiving slot.

10 63. The surgical stapler according to claim 62, wherein each capsule encapsulates a quantity of biocompatible wound closure material therein.

64. The surgical stapler according to claim 63, wherein each capsule is adapted to rupture upon application of a compressive force.

15 65. The surgical stapler according to claim 64, wherein the compressive force is applied to each of the capsules by the distal advancement of the fingers receivable within the needle receiving slots and through the respective needle receiving slots.

20 66. The surgical stapler according to claim 65, wherein distal advancement of the fingers receivable within the needle receiving slots causes the plurality of needles to deploy.

25 67. The surgical stapler according to claim 55, wherein the body tissue property reinforcing system is configured and adapted to deliver an amount of electrical energy to the adjacent layers of body tissue to cauterize the adjacent layers of body tissue to one another.

30 68. The surgical stapler according to claim 55, wherein the body tissue property enhancing system is configured and adapted to deliver an amount of electrical energy to at least one of the adjacent layers of body tissue to cauterize the adjacent layers of body tissue to one another.

69. The surgical stapler according to claim 68, wherein distal advancement of the fingers receivable within the needle receiving slots causes the plurality of needles to deploy.

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70. The surgical stapler according to claim 69, wherein the anvil member includes a plurality of contact pads disposed, one each, in juxtaposed axial alignment with each of the plurality of deployable needles.

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71. The surgical stapler according to claim 70, wherein each of the plurality of fingers receivable within the needle receiving slots, each of the plurality of needles and each of the contact pads are made from an electrically conductive material.

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72. The surgical stapler according to claim 71, wherein each of the plurality of fingers receivable within the needle receiving slots is electrically connected to a power line adapted to deliver electrical energy to the plurality of fingers receivable within the needle receiving slots.

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73. The surgical stapler according to claim 72, wherein each of the plurality of contact pads are electrically connected to a power line adapted to at least one of deliver and dissipate electrical energy to and/or from each of the plurality of contact pads.

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74. The surgical stapler according to claim 73, wherein each of the plurality of fingers receivable within the needle receiving slots, each of the plurality of needles and each of the contact pads are electrically connected to a source of electrical energy.